Claims

What is claimed is:

1. A semiconductor device comprising:

at least one free magnetic layer; and

a magnetic amplifier interacting with the free magnetic layer and comprising two or more magnetic layers with at least one nonmagnetic layer therebetween.

2. The device of claim 1, wherein the nonmagnetic layer is configured to provide parallel exchange coupling J of the magnetic layers in a range of $0 < J < \frac{4\pi t^2 M_S^2 n_y}{b}$, the magnetic layers having a long axis and a short axis, wherein t is a thickness of each magnetic layer, M_s is magnetization, n_y is a demagnetizing factor defined along the short axis of the magnetic layers and b is a diameter along the short axis of the magnetic layers.

3. The device of claim 1, wherein the nonmagnetic layer is configured to provide parallel exchange coupling J of the magnetic layers such that a switching threshold field H_t associated with the magnetic amplifier is substantially zero.

4. The device of claim 1, wherein the nonmagnetic layer is configured to provide parallel exchange coupling J of the magnetic layers such that a coercivity H_c associated with the magnetic amplifier is substantially zero.

5. The device of claim 1, wherein the nonmagnetic layer is configured to provide parallel exchange coupling J of the magnetic layers such that a threshold field H_t and a coercivity H_c associated with the magnetic amplifier are substantially zero.

6. The device of claim 1, further comprising a nonmagnetic spacer layer between the free magnetic layer and the magnetic amplifier.

7. The device of claim 6, wherein the nonmagnetic spacer layer prevents coupling of the free magnetic layer and the magnetic amplifier.

8. The device of claim 1, wherein the free magnetic layer and the magnetic amplifier interact by dipole fields.

9. The device of claim 1, comprising two or more free magnetic layers tightly anti-parallel coupled together.

10. The device of claim 1, wherein the nonmagnetic layer comprises an alloy.

11. The device of claim 10, wherein the alloy comprises an element selected from the group consisting of ruthenium, osmium, rhenium, rhodium, molybdenum, iridium, chromium, copper, vanadium and combinations comprising at least one of the foregoing.

12. The device of claim 1, wherein the free layer has an elliptical shape.

13. The device of claim 1, wherein the layers of the amplifier have an elliptical shape.

14. The device of claim 1, wherein the amplifier comprises an easy axis amplifier.

15. The device of claim 1, wherein the amplifier is deposited on top of the free layer.

16. The device of claim 1, wherein the amplifier is deposited beneath the free layer.

17. A method for switching a semiconductor device having at least one free magnetic layer, the method comprising the steps of:

providing an easy axis amplifier interacting with the free magnetic layer and comprising two or more magnetic layers with at least one nonmagnetic layer therebetween; and

writing the amplifier to produce a dipole field to switch the device.

18. An integrated circuit device including at least one semiconductor device, the at least one semiconductor device comprising:

at least one free magnetic layer; and

a magnetic amplifier interacting with the free magnetic layer and comprising two or more magnetic layers with at least one nonmagnetic layer therebetween.

19. The integrated circuit device of claim 18, wherein the integrated circuit device comprises a magnetic random access memory.